03P00077

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(54) **System and method of imaging using a variable speed table for thorax imaging**

(57) A system (10) and method of medical imaging using a variable speed patient positioning table (46) are provided. The patient positioning table (46) is configured to operate at a plurality of table speeds during acquisition of data from a selected region, such as the thorax region having predefined cardiac (52) and non-cardiac regions (54). In a non-cardiac region (54), the table (46) is controlled to move at one speed and when the cardiac region (52) is detected, the table (46) is controlled to move at another speed, preferably faster than in the cardiac region (52) to speed data acquisition and eliminate motion artifacts.
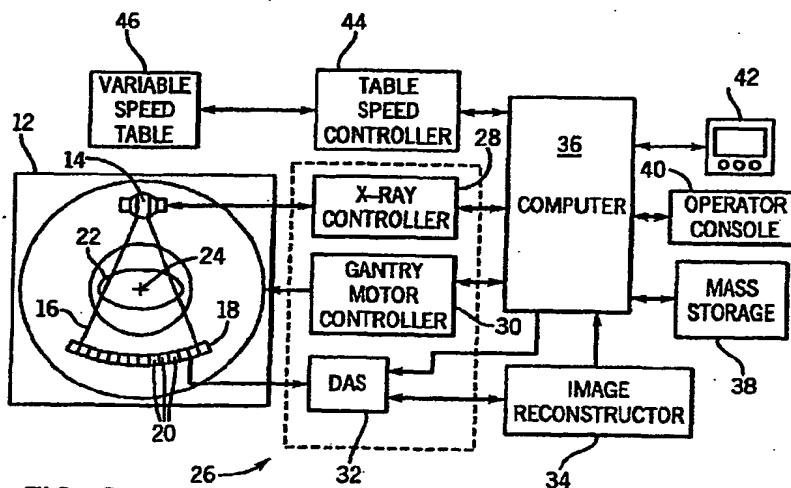
FIG. 2

EP 1 340 460 A1

Description

[0001] The present invention relates generally to medical imaging and, more particularly, to a system and method of imaging a thorax using a variable speed patient-positioning table, preferably in computed tomography systems.

[0002] Typically, in computed tomography (CT) imaging systems, an x-ray source emits a fan-shaped beam toward an object, such as a patient. The beam, after being attenuated by the patient, impinges upon an array of radiation detectors. The intensity of the attenuated beam radiation received at the detector array is typically dependent upon the attenuation of the x-ray beam by the patient. Each detector element of the detector array produces a separate electrical signal indicative of the attenuated beam received by each detector element. The electrical signals are transmitted to a data processing unit for analysis which ultimately results in the formation of an image.

[0003] Generally, the x-ray source and the detector array are rotated with a gantry within an imaging plane or around the patient. X-ray sources typically include x-ray tubes which emit the x-ray beam at a focal point. X-ray detectors typically include a collimator for collimating x-ray beams received at the detector, a scintillator for converting x-rays to light energy adjacent the collimator, and photodiodes for receiving the light energy from the adjacent scintillator.

[0004] In one known CT imaging system used to image a thorax, imaging is conducted by moving a patient table through a gantry at a constant speed. Generally, the constant table speed is determined by matching the speed of the table to the phase of a patient's cardiac cycle with EKG gating. Problems arise, however, using such a system since the table speed is required to move at a very slow speed throughout imaging in order to have sufficient coverage of the heart at a prescribed phase. Using a slow table speed throughout imaging has several disadvantages such as patient discomfort, limited patient accessibility to the CT system, and a higher x-ray radiation dose to the patient for slower acquisition for the same coverage area. One proposed solution to this problem considered increasing the table speed during imaging. This solution, however, is not suitable for thorax imaging because of the occurrence of motion artifacts. Motion artifacts are caused by motion of the imaged thorax or a part of the imaged thorax, such as the heart, during the imaging sequence causing a blurring in the reconstructed image in the regions where motion occurs. It is well known in the art that motion artifacts can be minimized during imaging of the thorax if the imaging sequence is gated to the cardiac cycle of the patient.

[0005] It would therefore be desirable to have a CT imaging system capable of speeding up the imaging time to image a thorax region of a patient without generating motion artifacts in the reconstructed image.

[0006] The present invention seeks to provide a variable speed table for a CT imaging system and method of use that solves the aforementioned drawbacks.

[0007] The invention includes a system and a method of computer tomography imaging using a variable speed patient positioning table are provided. The system includes a high frequency electromagnetic energy projection source to project towards an object, such as a patient. A detector receives the high frequency energy attenuated by the patient. A plurality of electrical interconnects is configured to transmit detector output to a data processing system to produce a visible display. A rotatable gantry has a patient positioning table passing therethrough. The patient positioning table is configured to operate at a plurality of table speeds during acquisition of a set of data from a selected region, such as the thorax region of a patient. A cardiac imaging method of acquiring a set of data values during imaging of the cardiac scanning region and at least one non-cardiac scanning region to reconstruct an image is also provided.

[0008] In accordance with one embodiment of the present invention, a cardiac imaging method includes the steps of positioning a patient on a variable speed table of an imaging device, determining a cardiac scanning region and at least one non-cardiac scanning region, moving the variable speed table at a primary velocity during imaging of the cardiac scanning region, and moving the variable speed table at a secondary velocity during imaging of the at least one non-cardiac scanning region. The method further includes the steps of acquiring data during imaging of the cardiac scanning region and the at least one non-cardiac scanning region, and reconstructing an image based on the data acquired at differing table speeds.

[0009] In accordance with another embodiment of the invention, a computed tomography system is provided. This system includes a projection source to project towards an object and a detector to receive high frequency electromagnetic energy attenuated by the object. The detector produces outputs that are transmitted to a data processing system by a plurality of electrical interconnects. The system further includes a computer capable of producing a visual display based upon the photodiode outputs transmitted to the data processing system and control a speed of the patient positioning table in response to detection of a particular region of the object. This system also includes a patient positioning table having variable speed capability and configured to operate at a plurality of table speeds during acquisition of a set of data from a selected region.

[0010] In accordance with yet another embodiment of the invention, a computer-readable medium having stored thereon a computer program which, when executed by a computer, will cause the computer to determine a cardiac scanning region and a non-cardiac scanning region, move a variable speed table at a primary velocity in the cardiac scanning region, and move the variable speed table at a secondary velocity in the non-

cardiac scanning region. The computer program also has instructions to acquire a set of imaging data in the cardiac scanning region and in the non-cardiac scanning region, and reconstruct an image based on data acquired using at least two different table speeds.

[0011] The invention will now be described in greater detail, by way of example, with reference to the drawings, in which:-

Fig. 1 is a perspective view of a CT imaging system.

Fig. 2 is a perspective block schematic diagram of the system illustrated in Fig. 1.

Fig. 3 is a flow chart showing a process of the present invention and implemented in the system of Fig. 1.

[0012] A system and method is described for a computed tomography (CT) system capable of imaging a thorax. It will be appreciated by those of ordinary skill in the art that the present invention is equally applicable for use with single-slice or other multi-slice configurations. Moreover, the present invention will be described with respect to the detection and conversion of x-rays. However, one of ordinary skill in the art will further appreciate, that the present invention is equally applicable in other imaging modalities.

[0013] Referring to Figs. 1 and 2, an exemplary computed tomography (CT) imaging system 10 is shown as including a gantry 12 representative of a "third generation" CT scanner. Gantry 12 has an x-ray source 14 that projects a beam of x-rays 16 toward a detector array 18 or the opposite side of the gantry 12. Detector array 18 is formed by a plurality of detectors 20 which together sense the projected x-rays that pass through a medical patient 22. Each detector 20 produces an electrical signal that represents the intensity of an impinging x-ray beam and hence the attenuated beam as it passes through the patient 22. During a scan to acquire x-ray projection data, gantry 12 and the components mounted thereon rotate about a center of rotation 24. Detector array 18 and detectors 20 can be any number of high frequency electromagnetic energy detectors, such as gas-filled, scintillation cell-photodiode, and semiconductor detectors as is know to those skilled in the art of detector design.

[0014] Rotation of gantry 12 and the operation of x-ray source 14 are governed by a control mechanism 26 of CT system 10. Control mechanism 26 includes an x-ray controller 28 that provides power and timing signals to an x-ray source 14 and a gantry motor controller 30 that controls the rotational speed and position of gantry 12. A data acquisition system (DAS) 32 in control mechanism 26 samples analog data from detectors 20 and converts the data to digital signals for subsequent processing. An image reconstructor 34 receives sampled and digitized x-ray data from DAS 32 and performs highspeed reconstruction. The reconstructed image is applied as an input to a computer 36 which stores the image in a mass storage device 38.

[0015] Computer 36 also receives commands and scanning parameters from an operator via console 40 that has a keyboard. An associated cathode ray tube display 42 allows the operator to observe the reconstructed image and other data from computer 36. The operator supplied commands and parameters are used by computer 36 to provide control signals and information to DAS 32, x-ray controller 28 and gantry motor controller 30. In addition, computer 36 operates a table speed controller 44 which controls a variable speed table 46 during imaging of a patient 22 within gantry 12. Particularly, table 46 is configured to move a patient 22 through a gantry opening 48 along an axis 50.

[0016] In operation, a patient 22 or object is positioned within the CT scanner or imaging device 10 on the variable speed table 46 with a selected region of the patient chosen for scanning adjacent to the gantry 12. A technician or healthcare operator enters input into the operator console 40, thereby defining a scanning region, such as the thorax which includes cardiac region 52 and non-cardiac regions 54. The computer 36 then instructs the table speed controller 44 to move the variable speed table 46 at a first table speed towards the gantry opening 48 causing the patient 22 to enter therein. As one of the non-cardiac regions 54 of the patient 22 enters the gantry opening 48, control mechanism 26 causes x-ray controller 28 to provide power and timing signals to x-ray source 14 while the gantry motor controller 30 causes rotation of gantry 12 to begin the imaging scan of the non-cardiac region 54.

[0017] Table speed controller 44 continues to move the patient 22 through the gantry opening 48 to conduct an imaging scan of the cardiac region 52 at a second table speed, different than the first. The table is then adjusted again when other non-cardiac region 54 of the thorax is reached. The first table speed is preferably configured to move faster than the second table speed since motion artifacts are not created by contraction of the heart muscle in the non-cardiac regions 54. Consequently, scanning times for imaging of the thorax are reduced. After scanning the thorax, detectors 20 send the x-ray data acquired from the cardiac region 52 and non-cardiac regions 54 to DAS 32 and image reconstructor 34 for digitalization and image reconstruction. Computer 36 then processes the digitized x-ray data to provide a reconstructed image of the cardiac region 52 and non-cardiac regions 54 on display 42.

[0018] Referring to Fig. 3, a flowchart illustrating the steps of a method and acts associated with a computer program in accordance with the present invention are shown. The method and/or computer program is initiated at 100 by a technician or CT scanner operator who provides input into the computer to define a set or regions to be scanned 102, such as a cardiac scanning region and adjacent non-cardiac scanning regions of a

patient's thorax. Generally, such operator entered input can include a starting position and an ending position along a common axis, such as axis 50 of Fig. 1. An image reconstruction point is then calculated 104, which is preferably centrally positioned between the starting and ending input positions, or end points of the defined thorax region. The method decides at 106 whether the region to be scanned is a cardiac scanning region, and if so 108, acquires data values with the patient table moving at a primary velocity 110. For a non-cardiac scanning region 112, data values are acquired with the patient table moving at a secondary velocity 114. As previously discussed, the variable speed table is preferably configured to move at a faster velocity during scanning in non-cardiac scanning regions and a slower velocity in the cardiac scanning region where motion artifacts can occur due to motion of the heart. In a preferred embodiment, the scanning of the cardiac scanning region has a primary velocity that is equivalent to an EKG gating speed of the scanned patient with the EKG gating speed determined according to a diastole phase of the patient's cardiac cycle.

[0019] After acquiring data values 110, 114, a distance between the position where each data value is acquired and the image reconstruction location or point is calculated 116. Using the calculated distances, the data values are weighted 118 according to the distance of each of the data values from the image reconstruction location and stored in memory of the computer 120. The method next proceeds to determine whether the entire thorax region has been scanned 122. If the thorax region has not been scanned 124, then the method loops back to step 106 and again determines whether the region to be scanned is a cardiac region 106. The method then continues to collect data values for the identified region of the thorax.

[0020] Data values are acquired as the variable speed table moves through the gantry, with the acquired data values for the thorax scanning region taken with the table moving at the generally faster secondary velocity in the non-cardiac regions, and at the slower primary velocity in the cardiac region where the EKG gating speed of a diastole phase of a patient's cardiac cycle determines the primary velocity in the cardiac region. Data values acquired further away from the image reconstruction location are accorded less weight during image reconstruction providing an improved reconstructed image. After the data values are acquired, they can be combined to form a single set of data values, and then summed for image reconstruction.

[0021] Upon completion of scanning of the thorax region 126, an image is reconstructed using the combined set of acquired and weighted data values 128. A reconstructed image can then be shown on a cathode ray tube display, or alternatively, stored in memory for later use. The method then ends at 130.

[0022] In one alternative embodiment, the transition of the variable speed table can be transitioned at step 124 by incrementally changing the speed, in a linear transgression, or in a step-wise incrementation, or any other transition method that permits scanning to occur in the non-cardiac regions at a faster rate than in the cardiac region. The scanning time required to image a patient is thereby reduced as compared to the time spent scanning a patient at a primary velocity determined by a patient's cardiac cycle.

[0023] As previously discussed and in accordance with one aspect of the present invention, a cardiac imaging method comprises the steps of positioning a patient on a variable speed table of an imaging device, determining a cardiac scanning region and at least one non-cardiac scanning region, and moving a variable speed table at a primary velocity during imaging of the cardiac scanning region and at a secondary velocity during imaging of the at least one non-cardiac scanning region. The method further includes the steps of acquiring data during imaging of the cardiac scanning region and the at least one non-cardiac scanning region, and reconstructing an image of the region scanned based on the data acquired at differing table speeds.

[0024] In accordance with another aspect of the invention, a computed tomography system is provided capable of imaging human anatomy, such as a thorax. This system includes a high frequency electromagnetic energy projection source to project high frequency energy towards an object or patient and a scintillator array having a plurality of scintillators to receive high frequency electromagnetic energy attenuated by the object/patient. A photodiode array is optically coupled to the scintillator array and is configured to detect light energy emitted therefrom. The photodiode array produces outputs that are transmitted to a data processing system by a plurality of electrical interconnects. The system further includes a computer capable of producing a visual display based upon the photodiode outputs transmitted to the data processing system and control a speed of the patient positioning table in response to detection of a particular region of the object. This system also includes a patient positioning table having variable speed capability and configured to operate at a plurality of table speeds, such as a primary and secondary velocity, during acquisition of data from a selected region.

[0025] In accordance with yet another aspect of the invention, a computer-readable medium having stored thereon a computer program which, when executed by a computer, will cause the computer to determine a cardiac scanning region and a non-cardiac scanning region, move a variable speed table at a primary velocity in the cardiac scanning region, and move the variable speed table at a secondary velocity in the non-cardiac scanning region or regions. The computer program also has instructions to acquire data of the cardiac scanning region and the non-cardiac scanning region, and reconstruct an image based on the data acquired at more than one table speed.

[0026] For the sake of good order, various aspects of

the invention are set out in the following clauses:-

1. A cardiac imaging method (100) comprising the steps of:

positioning a patient (22) on a variable speed table (46) of an imaging device (10);
determining a cardiac scanning region (52) and at least one non-cardiac scanning region (54);
moving the variable speed table (46) at a primary velocity during imaging of the cardiac scanning region (52);
moving the variable speed table (46) at a secondary velocity during imaging of the at least one non-cardiac scanning region (54);
acquiring data during imaging of the cardiac scanning region (52) and the at least one non-cardiac scanning region (54); and
reconstructing an image (128) based on the data acquired at differing table speeds.

2. The method (100) of clause 1 wherein the secondary velocity is at a speed greater than the primary velocity.

3. The method (100) of clause 1 further comprising the step of transitioning the variable table speed incrementally during changes in the speed of the variable table speed.

4. The method (100) of clause 1 wherein the primary velocity is an EKG gating speed of the patient (52).

5. The method (100) of clause 4 wherein the EKG gating speed is determined according to a diastole phase of a patient's cardiac cycle.

6. The method (100) of clause 1 further comprising the step of weighting the acquired data (118) according to a distance between a position where each data value is acquired and an image reconstruction location (116).

7. The method (100) of clause 6 wherein the weighting of the acquired data (118) is reduced as the distance between the position where each data is acquired and the image reconstruction location increases.

8. The method (100) of clause 1 wherein the imaging device (10) includes a CT scanner.

9. A computed tomography system (10) comprising:

a high frequency electromagnetic energy projection source (14) to project high frequency energy (16) towards an object;
a detector (20) to receive high frequency electromagnetic energy (16) attenuated by the object;
a plurality of electrical interconnects configured to transmit detector outputs to a data processing system (32);
a patient positioning table (46) having variable speed capability and configured to operate at a plurality of table speeds during acquisition of data from a selected region; and
a computer (36) to produce a visual display (42) based upon the detector (20) outputs transmitted to the data processing system (32) and control a speed of the patient positioning table (46) in response to detection of a particular region of the object.

10. The system (10) of clause 9 wherein the selected region is a thorax region of a patient and the particular region includes a cardiac scanning region (52) and a non-cardiac scanning region (54).

11. The system (10) of clause 10 wherein the patient positioning table (46) operates at a first table speed in the cardiac scanning region (52) and a second table speed in the non-cardiac scanning region (54).

12. The system (10) of clause 11 wherein the second table speed in greater than the first table speed.

13. The system (10) of clause 11 further comprising a control (44) is configured to detect a change in the particular region and vary the speed of the patient positioning table (46) in response thereto.

14. The system (10) of clause 13 wherein the control (44) causes the patient positioning table (46) to have one of an incremental change and a linear change in patient positioning table speed during changes in the patient positioning table speed in the selected region.

15. The system (10) of clause 11 wherein the first table speed is an EKG gating speed determined according to a diastole phase of a patient's cardiac cycle.

16. The system (10) of clause 9 wherein the computer (36) defines a location of an image reconstruction according to an operator entered input.

17. The system (10) of clause 16 wherein the operator entered input includes a starting position and an ending position sharing a common axis (50) for the acquisition of data.

18. The system (10) of clause 16 wherein the data is weighted (118) according to the distance of each

acquired data value to the location of the image re-construction.

19. A computer-readable medium having stored thereon a computer program which, when executed by a computer (36), will cause the computer (36) to:

> determine a cardiac scanning region (52) and a non-cardiac scanning region (54);
> move a variable speed table (46) at a primary velocity in the cardiac scanning region (52);
> move the variable speed table (46) at a secondary velocity in the non-cardiac scanning region (54);
> acquire a set of imaging data in the cardiac scanning region (52) and in the non-cardiac scanning region (52); and
> reconstruct an image based on data acquired (128) using at least two different table speeds.

20. The computer-readable medium of clause 19 wherein the computer program stored thereon causes the computer (36) to determine an image reconstruction location (104) between a pair of operator entered inputs.

21. The computer-readable medium of clause 20 wherein the image reconstruction location is centrally positioned between the pair of operator entered inputs.

22. The computer-readable medium of clause 20 wherein the computer program stored thereon causes the computer (36) to weight the acquired imaging data (118) according to a distance from a position at which each data value is acquired to the image reconstruction location (116).

23. The computer-readable medium of clause 22 wherein the weighting of each acquired data value (118) decreases as the distance from the position at which each data value is acquired to the image reconstruction location increases.

24. The computer-readable medium of clause 19 wherein the primary velocity is an EKG gating speed of a patient (22) determined according to a diastole phase of the patient's cardiac cycle.

25. The computer-readable medium of clause 23 wherein the weighted data values (118) are summed to reconstruct an image.

26. The computer-readable medium of clause 19 wherein the primary velocity is less than the secondary velocity.

Claims

1. A cardiac imaging method (100) comprising the steps of:

> positioning a patient (22) on a variable speed table (46) of an imaging device (10);
> determining a cardiac scanning region (52) and at least one non-cardiac scanning region (54);
> moving the variable speed table (46) at a primary velocity during imaging of the cardiac scanning region (52);
> moving the variable speed table (46) at a secondary velocity during imaging of the at least one non-cardiac scanning region (54);
> acquiring data during imaging of the cardiac scanning region (52) and the at least one non-cardiac scanning region (54); and
> reconstructing an image (128) based on the data acquired at differing table speeds.

2. The method (100) of claim 1 wherein the secondary velocity is at a speed greater than the primary velocity.

3. The method (100) of claim 1 or 2 further comprising the step of transitioning the variable table speed incrementally during changes in the speed of the variable table speed.

4. The method (100) of claim 1, 2 or 3 wherein the primary velocity is an EKG gating speed of the patient (52).

5. A computed tomography system (10) comprising:

> a high frequency electromagnetic energy projection source (14) to project high frequency energy (16) towards an object;
> a detector (20) to receive high frequency electromagnetic energy (16) attenuated by the object;
> a plurality of electrical interconnects configured to transmit detector outputs to a data processing system (32);
> a patient positioning table (46) having variable speed capability and configured to operate at a plurality of table speeds during acquisition of data from a selected region; and
> a computer (36) to produce a visual display (42) based upon the detector (20) outputs transmitted to the data processing system (32) and control a speed of the patient positioning table (46) in response to detection of a particular region of the object.

6. The system (10) of claim 5 wherein the selected region is a thorax region of a patient and the particular

region includes a cardiac scanning region (52) and a non-cardiac scanning region (54).

7. The system (10) of claim 5 or 6 wherein the patient positioning table (46) operates at a first table speed in the cardiac scanning region (52) and a second table speed in the non-cardiac scanning region (54).

8. A computer-readable medium having stored thereon a computer program which, when executed by a computer (36), will cause the computer (36) to:

> determine a cardiac scanning region (52) and a non-cardiac scanning region (54);
> move a variable speed table (46) at a primary velocity in the cardiac scanning region (52);
> move the variable speed table (46) at a secondary velocity in the non-cardiac scanning region (54);
> acquire a set of imaging data in the cardiac scanning region (52) and in the non-cardiac scanning region (52); and
> reconstruct an image based on data acquired (128) using at least two different table speeds.

9. The computer-readable medium of claim 8 wherein the computer program stored thereon causes the computer (36) to determine an image reconstruction location (104) between a pair of operator entered inputs.

10. The computer-readable medium of claim 9 wherein the image reconstruction location is centrally positioned between the pair of operator entered inputs.
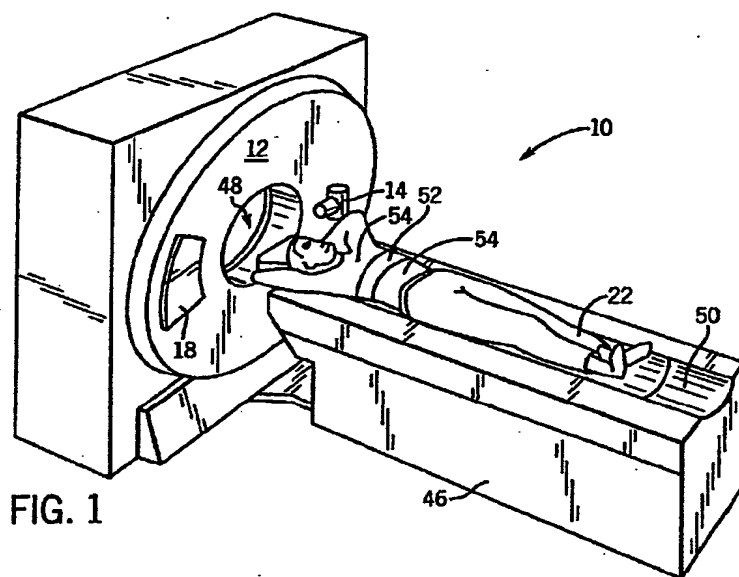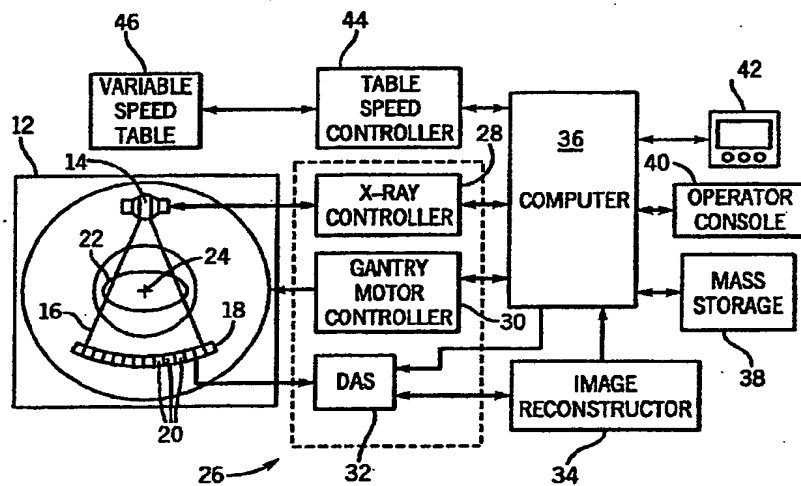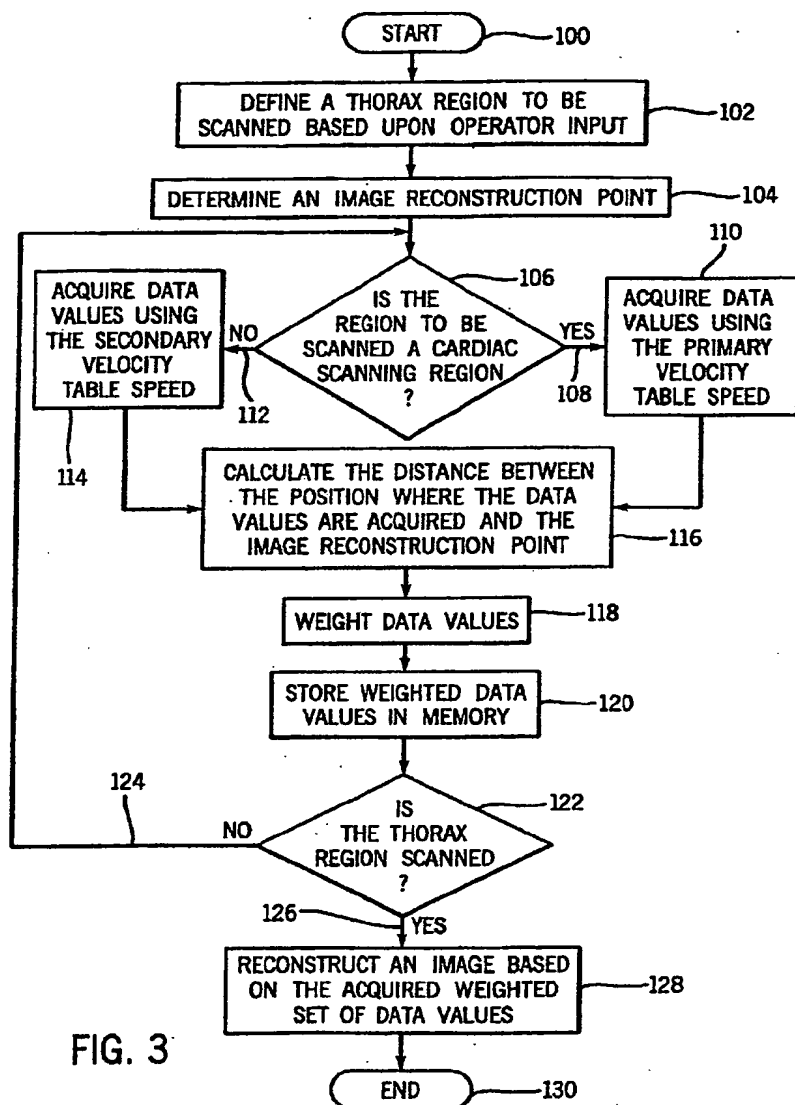
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FIG. 1

FIG. 2

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                        ┌──────────┐
                        │  START   │──── 100
                        └──────────┘
                             │
              ┌──────────────────────────────────┐
              │  DEFINE A THORAX REGION TO BE     │──── 102
              │  SCANNED BASED UPON OPERATOR INPUT │
              └──────────────────────────────────┘
                             │
              ┌──────────────────────────────────┐
              │  DETERMINE AN IMAGE RECONSTRUCTION POINT │──── 104
              └──────────────────────────────────┘
                             │                        110
                             │                         │
  ┌─────────────┐      ╱─────────────╲        ┌─────────────┐
  │ ACQUIRE DATA│     ╱   IS THE       ╲       │ ACQUIRE DATA│
  │ VALUES USING│ NO ╱   REGION TO BE   ╲ YES  │ VALUES USING│
  │ THE SECONDARY├───┤  SCANNED A CARDIAC ├────┤ THE PRIMARY │
  │ VELOCITY    │    ╲  SCANNING REGION  ╱      │ VELOCITY    │
  │ TABLE SPEED │     ╲      ?          ╱  108  │ TABLE SPEED │
  └─────────────┘      ╲─────────────╱         └─────────────┘
         │            112                           │
       114                                          │
         │         ┌──────────────────────────────┐ │
         └─────────│ CALCULATE THE DISTANCE BETWEEN│─┘
                   │  THE POSITION WHERE THE DATA  │
                   │  VALUES ARE ACQUIRED AND THE  │──── 116
                   │  IMAGE RECONSTRUCTION POINT   │
                   └──────────────────────────────┘
                             │
                   ┌──────────────────┐
                   │ WEIGHT DATA VALUES│──── 118
                   └──────────────────┘
                             │
                   ┌──────────────────┐
                   │ STORE WEIGHTED DATA│──── 120
                   │ VALUES IN MEMORY  │
                   └──────────────────┘
                             │
   124                 ╱─────────────╲
    │           NO    ╱   IS          ╲──── 122
    └─────────────────┤  THE THORAX    │
                      ╲  REGION SCANNED ╱
                       ╲      ?        ╱
                        ╲─────────────╱
                   126───┐  │ YES
                   ┌──────────────────────────┐
                   │ RECONSTRUCT AN IMAGE BASED│
                   │ ON THE ACQUIRED WEIGHTED  │──── 128
                   │ SET OF DATA VALUES        │
                   └──────────────────────────┘
                             │
                        ┌──────────┐
                        │   END    │──── 130
                        └──────────┘
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FIG. 3

EUROPEAN SEARCH REPORT

Application Number

EP 03 25 1140

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	EP 1 072 224 A (GEN ELECTRIC) 31 January 2001 (2001-01-31) * column 1, line 57 - column 2, line 24 * ---	1,5,8	A61B6/00
A	DE 199 57 082 A (SIEMENS AG) 2 August 2001 (2001-08-02) * column 3, line 19 - line 54 * -----	1,5,8	

TECHNICAL FIELDS
SEARCHED   (Int.Cl.7)

A61B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	10 June 2003	Manschot, J

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.

EP 03 25 1140

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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10-06-2003

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
EP 1072224	A	31-01-2001	EP	1072224 A2	31-01-2001
			JP	2001061835 A	13-03-2001
DE 19957082	A	02-08-2001	DE	19957082 A1	02-08-2001
			JP	2001198121 A	24-07-2001
			US	6504893 B1	07-01-2003

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82